

Excess slurry is collected in a container and is recycled. The blocks fall into recessed regions in the substrate. Adhesives and spacers are deposited onto the substrate **504**. Display material is placed onto the substrate **508**. This material may comprise polymer-dispersed liquid crystal, cholesteric liquid crystal, electrophoretic liquid crystal, upconverting phosphor, or downconverting phosphor **512**.

[0091] **FIG. 15B** shows the overall process of fabricating a display device wherein a flexible substrate **120** and a display tape **160** undergo processing and are subsequently coupled. There, the flexible substrate is advanced along a first process line and advances through a first set of support members **122**. A first slurry **124** containing a plurality of blocks is dispensed onto the flexible substrate. A second slurry **126** containing a plurality of blocks is again dispensed onto the substrate. Excess slurry is collected in a container **128** and is recycled. The blocks fall into recessed regions in the substrate. It should be noted that a polarizing or retarding film could be deposited onto the substrate before the FSA process is applied to the substrate. Flexible substrate **120** is advanced through a second set of support members **130**. An interconnect **132** is then deposited onto flexible substrate **120**. The flexible substrate is then advanced to point **134**. In conjunction with this process, display tape **160** undergoes a separate process. Display material is placed onto at least one side of the display tape **160**. Display tape **160** is advanced through a first set of support members **164**. The display material is patterned or layered **168**. This display material may comprise polymer-dispersed liquid crystal, cholesteric liquid crystal, electrophoretic liquid crystal, upconverting phosphor, or downconverting phosphor. Display tape **160** is advanced through a second set of support members **170**. An interconnect **172** is either deposited or etched onto the display tape **160**. The display tape is then advanced to point **134** where the display tape is coupled to the substrate. A conveyor belt **174** surrounds the support members.

[0092] While the process may follow these steps, it should be noted that it is also possible that one portion of the display will be singulated prior to the display tape being attached to the substrate.

[0093] **FIG. 16** relates to a method of picking and placing of objects onto a flexible substrate after the FSA process has been applied to the substrate. A slurry containing a plurality of objects is dispensed onto the substrate **90**. The objects fall into recessed regions in the substrate. The excess slurry is collected and recycled **91**. The substrate is checked for empty recessed regions **92**. This checking is performed by an electronic eye that views the substrate. Objects are robotically placed into empty regions found in substrate **94**. A metalization material is placed onto at least one of the substrate's surfaces and is patterned or etched **96**. The display tape is coupled to the substrate **98**.

[0094] **FIG. 17** relates to the FSA process and the coupling of the display material with the substrate. First, a slurry containing a plurality of blocks is deposited onto the substrate **400**. If the recessed regions are of equivalent size, step **450** is then followed. If not, a first slurry with a first plurality of objects is deposited onto the substrate **410**. Excess slurry is caught and recycled **415**. Once this step is performed, a second slurry with a second plurality of objects is placed onto the substrate **420**. Excess second slurry is recycled into a second container **425**. A metal interconnect is then deposited onto the substrate **435**. After these steps, a display material is deposited onto the substrate **430**.

[0095] **FIG. 18** shows a flexible continuous substrate wherein two displays are created. Display device **52** is larger

than display device **50**. This shows that multiple displays of different sizes can be created on the substrate through an in-line process. Alternatively, **FIG. 19** shows displays **54** and **56** of similar size.

[0096] In addition to multiple displays being able to be made different sizes, the substrate itself may have different sized recessed regions. This allows the substrate to receive various sized blocks or devices. **FIG. 20** shows a cross-sectional view of the recessed regions in the substrate. Recessed region **65** is smaller than recessed region **67**.

[0097] **FIG. 21** shows an embodiment of the overall in-line process of the invention. A web apparatus machine **119** is used to process the substrate. At step **120**, apertures are created in the flexible substrate. These apertures can be created by a number of methods. For example, the apertures can be punched into the substrate. Another method involves using a template to create the apertures. A laser, chemical or plasma etching could also be used to create the apertures. The substrate advances over a plurality of support members **122**. The substrate goes in between support members **123** and **123B**. The FSA process is applied to the substrate. FSA comprises a slurry that contains a plurality of functional blocks. These blocks have, in one embodiment, a circuit element (not shown) that drives the picture element (not shown). The FSA process occurs at block **124**. It is then applied again at **126**. The excess slurry is collected in container **128**. Then, the flexible substrate advances through support members **130**. The flexible substrate then has an interconnect **131** deposited on the top of the flexible substrate **132**. The resulting flexible substrate advances over a guide member and meets at a point **134** wherein it is coupled to a display tape that in one embodiment is a flexible substrate that includes separate regions each having a display material on this flexible substrate. A different portion of the process involves the display tape **160**. Before the display tape is coupled with the substrate, the display tape goes through its own separate process that is described below.

[0098] The display tape has display material **162** deposited on at least one side of the display tape. There are a variety of ways that display material may be deposited onto the display tape. For example, display material may be sprayed onto the display tape. The display material also may be placed on a screen over the display tape. Another method is to place the display tape into a container that holds the display material. The display tape advances through support members **164**. The display tape then has display material layered or patterned on the display tape at **168**. This display tape then advances through another plurality of support members **170**. A large area metal interconnect is then deposited or etched onto the display tape **172**. This may be performed by inkjet, lithography and etch, screen print, laser etch, or deposit **174**. In one embodiment of the invention, this large interconnect is a cover glass electrode. At point **134**, the display tape is coupled with a substrate.

[0099] **FIG. 22** shows a display material being placed through a screen **180** onto display tape **168**. The screen **180** has a desired pattern created by holes that go through the screen **180**. This desired pattern may be dictated by a customer or by the manufacturer.

[0100] Another method of placing display material onto the display tape is shown in **FIG. 23**. **FIG. 23** shows a top view of display material being laser etched onto display tape **168**. The etching occurs when the high intensity light from the laser **182** strikes the display material on top of the display tape **168**. A pattern is created in the display material by the laser **182**.